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MERCURY IN MONTANA WILDLIFE

October, 1970

We have just completed reviewing the results from our 12-month testing for mercury residues in upland game birds and fish in Montana. Hungarian partridge collected in the north-central region was our primary test species, although pheasants and sharp-tailed grouse were also sampled. Many species of fish were sampled. Attention was focused on the mercury level in breast tissue in upland game birds and the fish were tested on an edible portion basis.

Upland bird testing began in early October, 1969, and at no time during the entire 12 months did mercury completely disappear (Table 1). Residues in tissue following fall, 1969 seeding of winter wheat were noticeably higher than levels permissible for human consumption at that time (0.05 ppm). Mercury levels increased during the winter months but dropped sharply prior to spring 1970 grain seeding. A second increase in levels was noted following spring seeding. There was a decline from July to August and only a slight increase in September. Few farmers in the test area were seeding winter wheat at the time of the September, 1970 collection. A crop taken from a hunter-shot bird in Teton County on September 12, however, contained a half-dozen mercury-treated wheat seeds.

Soil samples were tested from fallow, seeded, stubble hay and idle areas at the various collection sites in May. Thirty-four (87%) of the 39 samples showed mercury levels <0.10 ppm. Assuming soil to be the "background" level, 67% of the partridge exceeded this level (0.10 ppm) (Table 2). Grain (apparently the chief source of mercury for partridge) collected from fields at the same time showed 0.10, 0.09, 0.09, <0.05 and <0.05 ppm for five samples. Two of these five exceeded "background" levels for the area in which they were collected.

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Partridge eggs from collected females and nests were also tested. The shells and contents were tested separately; all contained mercury. Egg contents ranged < 0.10 - 0.17 ppm compared to < 0.10 ppm for all shells. Thus the newly hatched young carry mercury at or above "background" levels.

Restating the results of our Fall, 1969 pheasant testing, the birds ranged <0.05 - 0.47 ppm in breast tissue. The average for 15 birds was 0.17 ppm. Regionally the results were as follows:

Region	Average	Range
South-central	0.22 ppm	<0.05 - 0.47 ppm
Northeast	0.19	0.09 - 0.38
Southeast	0.10	<0.05 - 0.31

In early August, 1970, we collected 15 sharp-tailed grouse: five each from three regions. The results were:

Region	Average	Range
North-central	0.08 ppm	<0.05 - 0.14 ppm
South-central	0.05	<0.05 - 0.08
Southeast	<0.05	<0.05 (All 5 samples)

Hungarian partridge tested from this same collection period showed the following:

Region	Average	Range
North-central	0.07 ppm	0.06 - 0.09 ppm
South-central	0.07	<0.05 - 0.11
Southeast (1 bird)	<0.05	-

In summing up test results, Hungarian partridge, a by-product of Montana's small-grain growing region, contain mercury in their breast tissue throughout the year. The highest levels have been found after the hunting season closes; mercury apparently accumulates faster than it is purged, through the hunting season, to attain these levels. Mercury is passed from parents to chicks so all age classes contain mercury.

The pheasant, another by-product of grain growing areas, exhibited higher mercury levels than Hungarian partridge last fall. Presumably the fluctuation in mercury in pheasants follow those of partridge but on a higher plane.

Sharp-tailed grouse, an inhabitant of grasslands and overlapping into grain-producing areas, showed mercury at, or below, those in partridge.

Table 1. Mercury residue averages and ranges in Hungarian partridge breast tissue, October, 1969 - September, 1970.

Month	No. Birds	Mercury Average (ppm)	Mercury Range (ppm)
1969			
October	5	0.19	0.07 - 0.30
November	5	0.14	<0.05 - 0.20
December	5	0.35	<0.05 - 0.50
1970			
January	5	0.26	<0.05 - 0.48
February	5	0.39	0.31 - 0.53
March	5	0.24	0.16 - 0.33
April	4	0.04	<0.05 - 0.09
May	4	0.04	<0.05 - 0.06
June	5	0.12	0.06 - 0.22
July	4	0.25	0.20 - 0.36
August	7	0.14	0.07 - 0.22
September	9	0.11	<0.05 - 0.34

Table 2. Summary of mercury residues in Hungarian partridge breast tissue in north-central Montana, October, 1969 - September, 1970.

Mercury (ppm)	No. Birds	% of Total Birds
<0.05	9	14.3
0.05 - 0.10	12	19.0
0.11 - 0.20	18	28.6
0.21 - 0.30	6	9.5
0.31 - 0.40	12	19.0
0.41 - 0.50	5	7.9
>0.50	1	1.6
Totals	63	99.9

The first fish samples were taken for analysis in October of 1969. Since pulp mills were known to be sources of mercury contamination in other places, fish were collected from above and below Montana's only mill. While all the fish collected contained some mercury, none exceeded the Food and Drug Administration's interim tolerance level of 0.50 ppm. There was no apparent difference in samples taken from above or below the mill. Results of this sample are contained in table 3.

Table 3. Results of mercury analysis in the Clark Fork River near Missoula, October, 1969.

Species	Location	Mercury Concentration in parts per million
White Sucker	Below pulp mill	0.24
White Sucker	" " "	0.28
Whitefish	" " "	0.24
Whitefish	" " "	0.23
Brown Trout	" " "	0.18
Rainbow Trout	" " "	0.09
Whitefish	Above Harper Bridge & pulp mill	0.23
Whitefish	" " " " " "	0.23
Whitefish	" " " " " "	0.17

In an attempt to locate the source of mercury in these fish another sample of fish was taken from widely scattered points in the drainage. The results of these tests did not isolate a probable source of the mercury in the drainage. These results are presented in table 4.

Table 4. Results of mercury analysis in the Clark Fork Drainage, January, 1970.

Species	Location	Mercury Concentration in parts per million
Whitefish	Clark Fork R., Tavener Bridge above Garrison	0.27
Whitefish	" " " " " "	less than 0.05
Whitefish	" " " " " "	less than 0.05
Whitefish	Blackfoot R., Scotty Brown Bridge	0.12
Whitefish	" " " " "	0.14
Whitefish	" " " " "	less than 0.05
Whitefish	Bitterroot River below Hamilton	0.16
Whitefish	" " " "	less than 0.05
Whitefish	West Fork Bitterroot River	less than 0.05
Whitefish	" " " "	less than 0.05
Whitefish	" " " "	less than 0.05

During August of 1970 an extensive collection of fish from throughout Montana was made in cooperation with the Food and Drug Administration. Purpose of the collection was to analyze fish flesh for mercury. While most of the fish collected were found to be well within tolerances, one sample, taken from the Beaverhead River did show a high concentration of mercury in its flesh (Table 5).

Table 5. Results of mercury analysis in Montana fish, August, 1970.

Species	Location	Mercury Concentration in parts per million
Goldeye	Gregg Menge, Ft. Peck	.15
"	A & C Fish Co., Ft. Peck	.12
Buffalo	Ft. Peck	.20
Rainbow	Priest Lake	Trace
N. Pike	Arod Lake	.12
Brown Trout	Stillwater River, White Bird	.07
Sauger	Morony Dam	.20
Suckers	Otter Creek	.10
Walleye Pike	Nelson Reservoir	.18
Yellow Perch	Ft. Peck	.12
Brown Trout	Beaverhead River, Dillon	1.32*
N. Pike	Ft. Peck	.32
Walleye	Yellowtail	.06
Suckers	Deadman's Reservoir	.12
Brown Trout	Yellowtail	.27
Rainbow Trout	Yellowtail	.27
Trout	Yellowstone, Livingston	.07
Paddlefish	Yellowstone, Intake	.06
Suckers	Tongue River, Miles City	.23
Carp	Tongue River Reservoir	.19
Walleye	Tongue River Reservoir	.10
N. Pike	Tongue River Reservoir	.23
Sauger	Tongue River Reservoir	.16

*Represents reading above FDA recommended tolerance limit of 0.50 ppm.

In order to substantiate this analysis and perhaps isolate the source of mercury, an additional collection was made in the Beaverhead River and some of its tributaries. This particular sampling contained six collections that exceeded FDA tolerances. The results of these analysis are presented in table 6. The source is still not clearly indicated. It would appear, however, that the source of mercury in Montana streams is not related to agriculture as is suspected in the case of upland game birds, but rather to either a natural source or past mining operations.

Table 6. Results of mercury analysis in fish from the upper Beaverhead Drainage, September, 1970.

Species	Location	Mercury Concentration in ppm	Corroborating Analysis
Whitefish	Clark Canyon Reservoir	.12	
Rainbow Trout	Clark Canyon Reservoir	.18	
Suckers	Clark Canyon Reservoir	.15	
Ling	Clark Canyon Reservoir	.14	
Whitefish	Beaverhead R., (Pipe Organ Section)	.28	
Brown Trout	Beaverhead R., (Pipe Organ Section)	.18	
Suckers	Beaverhead R., (Pipe Organ Section)	.74*	0.72*
Brown Trout	Beaverhead R., (Grasshopper Cr.)	.28	
Whitefish	Beaverhead R., (Grasshopper Cr.)	.38	
Suckers	Beaverhead R., Below Grasshopper Cr	.57*	0.54*
Suckers	Beaverhead R., (Grasshopper Cr.)	.37	
Whitefish	Beaverhead R., (Dillon Sewage Outfall)	.54*	
Suckers	Beaverhead R., (Dillon Sewage Outfall)	.83*	.80*
Trout	Beaverhead R., (Dillon Sewage Outfall)	.58*	0.54*
Rainbow Trout	Rattlesnake Creek	.08	
Brown Trout	Grasshopper Creek	.83*	0.78*

*Represents reading above FDA recommended tolerance limit of 0.50 ppm.

Fish from two locations taken for the August collection were also sampled for other pesticide residues. These fish taken from Priest Lake (rainbow trout) and Nelson Reservoir (walleye) were sampled for chlorinated hydrocarbon and organophosphate pesticide residues. The results of these analysis indicated the fish were not contaminated according to Food and Drug Administration standards.